

DAVIDSON, UDEL
DHS Coastal Resilience Center
Research Project:
Annual Project Performance Report

Covers reporting period January 1, 2016 – June 30, 2016

1. Project Title: An Interdisciplinary Approach to Household Strengthening and Insurance Decisions

2. Principal Investigator / Institution:

Rachel Davidson, Professor, Civil Engineering, University of Delaware

3. Other Research Participants/Partners:

- Jamie Kruse, Professor, Economics, East Carolina University
- Linda Nozick, Professor, Civil Engineering, Cornell University
- Joseph Trainor, Assistant Professor, Public Policy, University of Delaware

4. Short Project Description:

This interdisciplinary project will improve a developing policy analysis tool to help agencies explore the potential effects of policies related to household hurricane risk reduction. The project specifically focuses on better understanding the factors that influence homeowner insurance purchase and retrofit decision-making.

5. Abstract:

Two primary mechanisms to manage natural disaster risk— insurance and retrofit—are presently underutilized, suggesting a need to better understand how homeowners make retrofit and insurance purchase decisions. Future programs and policies intended to reduce coastal natural disaster risk will be more effective if designed to align with how homeowners actually make these choices.

This project will advance understanding of (1) homeowner insurance purchase and retrofit decision-making and (2) the role it plays within the larger insurer-government-homeowner system of managing natural disaster risk. We will leverage two products from a NIST-funded research project we undertook recently—phone survey data and a holistic framework comprised of interacting mathematical models of hurricane risk, and homeowner and insurer decision-making that can help policy makers consider how specific policy alternatives might affect different stakeholder

groups.

In addition to advancing the scientific models and the broader mathematical framework, we expect four main near-term outcomes: (1) new discrete choice statistical models that describe homeowner insurance and retrofit decisions; (2) a prototype computer-based decision tool that can predict the percentage of homeowners in a region that will buy insurance and/or retrofit under different circumstances and hypothesized government policy interventions; (3) a “system win-win” white paper that describes the larger mathematical framework this project contributes to, including the insights they produce when combined, and the value that the system will provide to practitioners; and (4) a series of short, accessible policy briefs on the impact of low cost loans, grants, and insurance premium reductions on homeowner retrofit decisions; insurance adoption decisions; and the impact of hurricane experience on insurance purchases.

6. End users:

Five primary end users are involved in this project, representing both the mitigation and preparedness directorates of FEMA, state floodplain managers, and the NIST Community Resilience group (Table 1). For all, their role is as members of a project Advisory Panel from with whom we get regular input and feedback through biannual group, web-based meetings as well as occasional one-on-one offline interactions. There were other communications before the project officially started and another one shortly after the end of this reporting period, but no group call other than the one listed during the 6 month period of Year 1. In addition, the co-PI Joe Trainor has been working with Jackie Snelling (below) on a different effort over the last year and they have spoken a great deal about this over that time as well.

Table 1. Primary end users involved in project

Title	Organization	Role in project
Acting Division Director	FEMA Federal Insurance and Mitigation Administration, Risk Analysis Division	Advisory Panel
Senior Policy Advisor	FEMA Individual and Community Preparedness Division, National Preparedness Directorate	Advisory Panel
Executive Director	Association of State Floodplain Managers (ASFPM)	Advisory Panel
Research Economist	NIST Applied Economics Office/Community Resilience Group	Advisory Panel
Lead for Disaster Resilience	Materials and Structural Systems Division	Advisory Panel

Expected benefit to end users

The end users affiliated with this project are all charged with the management of national and local natural disaster risks. As part of their responsibilities, they must consider how to manage, improve, and incentivize risk reduction and loss management. Within this context, two main end user requirements have emerged that are particularly related to this project: (1) Motivating risk management actions among homeowners and other stakeholders, and (2) identifying win-win opportunities for risk reduction that engage multiple stakeholders.

First, a major part of being able to effectively manage risk is understanding how homeowners make insurance, retrofit, and other risk management decisions so that the government agencies can more effectively encourage and incentivize them to do so. These homeowner decisions are complex and depend on many factors, thus making it difficult to determine what combination of messages and incentives are most effective for different types of people experiencing different hazards under different community contexts and circumstances. In particular, the end users are interested in better understanding the likely effectiveness of different types of retrofit incentives, and how homeowner risk management decisions vary across hazards.

Another major challenge expressed by the end users is the need to identify and foster opportunities in which multiple stakeholders can be engaged in risk reduction and risk management activities in such a way that they all benefit and together help achieve community resilience. This “whole community” approach promoted by FEMA requires understanding both the decision-making drivers of each stakeholder, as well as how they interact. These questions are in line with those that our modeling framework intends to examine. As a result, the broader project vision provides a mental framework for end users to consider how risk management strategies and policies across stakeholders work together or against each other.

7. Explanation of Changes:

In response to a direct request from DHS in March/April, several changes were made to the original work plan for 2016. The changes were made to reflect incorporation of comments from DHS and to accommodate a substantial 25% Year 2 budget cut which forced us to reduce the student time working on the project. The primary changes are:

- Added development of a prototype computer-based decision tool (Transition Outcome #1)
- Removed task in which we would have replaced the current expected utility-based homeowner model in the modeling framework with the new discrete choice homeowner models and examined the effect on the overall system behavior. This was viewed as being of less interest to DHS and most of the end users than the other tasks.
- Added two policy briefs on insurance adoption and the impact of hurricane experience on homeowner protective action decision-making (in addition to the

- one already planned on incentives to encourage homeowner retrofit to mitigate hurricane damage).
- Moved development of the insurance purchase discrete choice model to occur before development of the retrofit decision discrete choice model.
 - Added a second summer intern from Tougaloo College.

8. Unanticipated Problems:

None.

9. Project Outcomes:

The framework being developed in this project will advance understanding of what form of incentives to increase insurance and mitigation adoption will be the most impactful, cost effective, and effective at reducing overall risk for a region. It will improve the ability of emergency managers to predict how mitigation incentives and insurance premiums and deductibles impact homeowner risk reduction.

Research Outcomes.

- All of the work pushes the team further towards a policy analysis tool based on the larger holistic framework.
- Discrete choice household decision models that help users understand how homeowners make insurance purchase and retrofitting decisions.
- Analysis of the impact hurricane experiences have on risk mitigation/insurance decisions
- Research presentations and publications

End User / Transition Outcomes.

- *Prototype decision tool.* Based on the results we have generated from our Eastern North Carolina based dataset, we will develop a simple prototype decision tool (possibly in the form of an excel spreadsheet, for example) that will allow policy makers to see how this type of work might be used to predict how adjustments to policy (e.g., mitigation incentives or insurance premium changes) would affect homeowner risks within a region. The tool will be based on application of the discrete choice models to predict homeowner protective action behavior at the regional scale. While there are limits to the generalizability of the tool given the data source, it could allow users to adjust some fields and see what might happen. For example, we might include a place where the user could enter how many years since a major event and see what happens to risk reduction activity levels. End users will be able to adjust assumptions based on local data. The tool will include a user manual explaining how to use it, and a technical manual explaining the statistics behind it.

- *System win-win white paper.* This white paper will explain how the larger mathematical framework we are developing represents a new approach to thinking about risk reduction policies. It will discuss how this work along with other parallel projects and future envisioned efforts are the foundation for a new decision tool with the potential to fundamentally change the national system of incentives and regulations related to insurance and mitigation thereby reducing coastal risk. More specifically, it will help identify solutions that are better both for each stakeholder type individually and for society as a whole. By recognizing the stakeholders' different perspectives up front as an integral part of the analysis, the modeling framework may make it possible to identify those win-win system-wide solutions that are most likely to be effective and that are easier to build a coalition around instead of finding solutions that are theoretically best but practically unworkable. This approach complements the traditional approach of making incremental changes to the existing system and focusing on how to convince homeowners and other stakeholders to undertake actions considered desirable for community resilience. It can help the end users think about creative ways to make transformative changes in how disaster risk is managed in the United States by forcing us to think about how key stakeholder's interests interact.

- *Policy briefs.* We intend to produce a series of short policy briefs that translate the scientific analyses in this project into digestible results. The work will address incentives to encourage homeowner retrofit to mitigate hurricane damage (e.g., grant that does not require repayment, reduction in insurance premium, or low interest loan), analysis of insurance adoption decisions, and analysis of the impact or hurricane experience on homeowner protective action decision-making. The briefs will directly address the end user interests in these scientific analyses and will translate the resulting insights into implications for practice and policy.

10. Research Activity and Milestone Progress:

Research Activities and Milestones: Progress to Date

Reporting Period 1/1/2016 – 6/30/2016			
Research Activity	Proposed Completion Date	% Complete	Explanation of why activity / milestone was not reached, and when completion is expected
Organize survey data and prepare software for statistical analysis	3/16	100%	
Formulate testable hypotheses based on end user interests and the protective action decision-making model (PADM). Our analysis will focus on the role of past hurricane experience on homeowner insurance purchase.	3/16	100%	We developed an analysis of how experience with hurricanes is linked to worry and fear. In addition we are analyzing the subsequent effects of these experiences and emotions on insurance purchase.
Begin fitting discrete choice models for decisions about insurance purchase.	6/16	100%	
Fit discrete choice models for decisions about insurance purchase.	8/16	100%	We were able to complete this ahead of schedule
Write journal paper about homeowner hurricane-related insurance decision-making	11/16	100%	We were able to complete this ahead of schedule
Begin fitting discrete choice models for decisions about homeowner hurricane-related retrofit decision-making, including consideration of incentives.	6/16	100%	
Begin testing hypotheses based on end user interests and PADM, specifically focused on hurricane experience and risk perception behavioral analysis.	6/16	100%	
Research Milestone			
Write journal paper about homeowner hurricane-related insurance decision-making	11/16	100%	We were able to complete this ahead of schedule. Some principal findings are included in footnote to this table.

* We found evidence that the following are all significant and associated with higher probability of purchasing insurance—lower premium, lower deductible, more recent previous hurricane experience, location in a floodplain or closer to the coast, higher income, and younger homeowners. However, demand is relatively inelastic with respect to premium and deductible, and the willingness to pay for a \$1 reduction in deductible varies throughout the population with some willing to pay more than \$1, a behavioral anomaly. The recency of the last hurricane experience is more influential for homeowners who experienced damage than for homeowners who did not. Importantly we

present statistical models that can be used to predict insurance penetration rates for a region under different premium levels.

Transition Activity and Milestone Progress:

Transition Activities and Milestones: Progress to Date

Reporting Period 1/1/2016 – 6/30/2016			
Transition Activity	Proposed Completion Date	% Complete	Explanation of why activity / milestone was not reached, and when completion is expected
Group conference call with research team and all end user partners to describe and get additional input on proposed plan	1/16	100%	The entire group participated and their input focused on helping us understand what types of output would be useful for them. They are particularly interested in incentives to encourage retrofit.
Begin writing System win-win white paper	6/16	100%	
Transition Milestone			
Next key milestone is in future period.			

11. Interactions with education projects:

In the Summer of 2016, we are hosting two 8-week summer interns from our CRC partner, Tougaloo College, at the Disaster Research Center at the University of Delaware. The students are Irenia Ball and Taralyn Rowell, both African American Female Seniors. While at UD they are contributing to this project by reviewing extant insurance literature and developing an inventory of mitigation programs currently being offered by states. These students have also visited the Delaware Legislature and with a group of non-profit leaders in Wilmington. They have also been interacting more generally with UD social science and engineering students and faculty interested in disaster studies. We were able to bring the second student by identifying supplemental funds from the University of Delaware to support her.

12. Publications:

Wang, D., Davidson, R., Trainor, J., Nozick, L., and Kruse, J. Homeowner purchase of insurance for hurricane wind and flood protection. *Natural Hazards*, in review (submitted July 7, 2016). (Wang, D. is a Ph.D. student)

13. CRC Performance Metrics:

CRC Performance Metrics			
Metric	Research Project	Education Project	Center
Courses/certificates developed, taught, and/or modified		See Table	
Enrollments in Center-supported courses/certificates			
HS-related internships (number)	0		
Undergraduates provided tuition/fee support (number)	0		
Undergraduate students provided stipends (number)	0		
Graduate students provided tuition/fee support (number)	2		
Graduate students provided stipends (number)	2		
Undergraduates who received HS-related degrees (number)	0		
Graduate students who received HS-related degrees (number)	0		
Certificates awarded (number)			
Graduates who obtained HS-related employment (number)	0		
SUMREX program students hosted (number)	2		
Lectures/presentations/seminars at Center partners (number)	0		
DHS MSI Summer Research Teams hosted (number)	0		
Journal articles submitted (number)	1		
Journal articles published (number)	0		
Conference presentations made (number)	0		
Other presentations, interviews, etc. (number)	0		
Patent applications filed (number)	0		
Patents awarded (number)	0		
Trademarks/copyrights filed (number)	0		
Requests for assistance/advice from DHS agencies (number)	0		
Requests for assistance/advice from other Federal agencies or state/local governments (number)	0		
Total milestones for reporting period (number)	1		
Accomplished fully (number)	1		
Accomplished partially (number)	0		
Not accomplished (number)	0		
Product/s delivered to end-user/s (description and recipients)	See Table		
External funding received	See Table		
Leveraged support			
Articles on Center-related work published on website (number)			
Coverage in media, blogs (number)			
Social media followers (number)			
Posts to social media accounts (number)			
Events hosted (number)			
Website hits (number)			

Table for Documenting CRC Research Project Product Delivery

Product Name	Product Type	Approx. Delivery	Recipient or Anticipated End
Insurance purchase	Journal paper	July 2016	Academic and professional

Table for Documenting External Funding and Leveraged Support

External Funding			
Title	PI	Total Amount	Source
Collaborative Research: An Interdisciplinary Approach to Modeling Multiple Stakeholder Decision-making to Reduce Regional Natural Disaster Risk, National Science Foundation	Davidson	\$306,555	NSF
Modeling natural disaster risk management: A stakeholder perspective	Davidson	\$797,000	NIST
Leveraged Support			
Description			Estimated Annual Value
DRC support of interns			\$1,000
UDEL School of Public Policy and Administration support of interns			\$1,000
UDEL Vice Provost of Diversity support of interns			\$3,000